REMARKS

Preferred embodiments of applicants' invention are directed to a fast scanning stage for a scanning probe microscope and a method of operating such a fast scanning stage. The scanning probe microscope includes a probe, and the stage comprises at least one fixed support and a sample stage having at least one axis of translation. As described in applicants' specification at page 7, paragraph [0024], the sample stage is affixed to the at least one fixed support by means for causing displacement of the stage relative to the probe. Thus, in the embodiment shown in Figs. 2A and 2B, sample stage 21 is fixed to supports 23 by actuators 22. Likewise, in the embodiment shown in Figs. 5A and 5B, sample stage 21 is fixed to rigid frame (support element) 51 by actuators 22.

In a preferred form, the means for causing relative displacement comprises at least one, and most preferably four, actuator elements that are attached to the sample stage through the fixed support. An embodiment showing four actuators 22 is shown in Figs. 2A and 2B. The actuator element or elements are preferably driven at the resonant frequency of the sample stage to permit fast line scans at a rate of several kHz which are free from turn around artifacts. Compare the "ringing" motion of prior art devices (see, Fig. 1D and paragraphs [0009] and [0010]) with the motion of applicants' scanning stage (Figs. 3A and 3B).

In the most recent Office Action, the Examiner finally rejected claims 1 and 12 under 35 USC §102(e) as anticipated by the newly-cited Sarkar et al (US 6806991). Sarkar relates to a "fully released" microstage that includes a "payload structure" such as a lens, mirror, or manipulator. The microstage is moved using actuators that are coupled to flexure elements. The Examiner asserted that Sarkar disclosed "a fast scanning stage for a scanning probe microscope" that included a probe (Fig. 9, 901), a sample stage (202), with the stage comprising at least one fixed support (Fig. 8b, 600). The sample stage is asserted to have at least one axis of translation.

Applicants first disagree with the Examiner's characterization of Sarkar as directed to a "fast scanning stage for a scanning probe microscope." Nowhere does Sarkar teach or suggest a "fast scanning stage," and Sarkar's purpose is to be able to produce fully decoupled movement of the microstage in both the X and Y directions simultaneously. See, Abstract and claim 1. Further, Sarkar's microstage is designed to position a lens or mirror, as well as a disclosed embodiment using a probe. Applicants' claimed fast

scanning stage is designed for providing motion along a single axis in a scanning probe microscope to complete fast scan lines which are free from turnaround artifacts.

Further, Sarkar's device is structurally different from applicants' claimed fast scanning stage. Claims 1 and 12 recite, *inter alia*, that the sample stage is "affixed to said at least one fixed support" by "means for causing displacement of said stage relative to said probe" (claim 1) or at least one actuator element" (claim 12). Thus, for example, in the embodiment shown in Figs. 2A and 2B, sample stage 21 is fixed to supports 23 by actuators 22. Sarkar's microstage, on the other hand, is designed to be "fully released." Applicants understand Sarkar's use of the term "fully released" to mean that the microstage is not anchored to any fixed structure, but instead is suspended from four flexure elements. For example, as shown in Fig. 2 of Sarkar, X-Y microstage 202 is suspended from flexures 201a-d. Flexures 201a-d are, in turn, connected to actuators 203a-d.

Thus, while Sarkar's microstage may be connected (indirectly through flexures) to actuator elements, there is no structure in Sarkar corresponding to the recited "at least one fixed support" of applicants' claims, nor to the affixation of the sample stage to such a fixed support. The Examiner asserted that structure in Sarkar corresponding to a fixed support was found in Fig. 8B, element 600. Fig. 8B depicts a "payload structure mechanically coupled to the XY stage and base structure shown in FIG. 8A" (see, col. 3, lines 66-67). Thus, as shown, base structure 600 is coupled to payload 850 by snap connectors 601. As described by Sarkar, base structure 600 includes a plurality of power pads 602, an electrostatic element 603, and feedback elements 604 --i.e., a capacitive detection substrate. Payload 850 is designed, for example, to be a lens or mirror that is coupled to the stage.

It is clear from a close reading of Sarkar, that base structure 600, while coupled (i.e., snap connected) to the microstage, is not affixed to anything except the microstage. And, Flexures 201a-d and actuators 203a-d certainly do not affix the microstage to that base structure. Rather, the snap connectors 601 do. The structure of Sarkar is different from and does not teach or suggest applicants' claimed structure. The rejection under §102 is not well taken and should be withdrawn.

Also in the Office Action, the Examiner rejected claims 2-6 and 13 under 35 USC §103 as unpatentable over Sarkar in view of newly-cited Flecha et al (US 5773824). Flecha relates to a scanning probe microscope using active lateral scanning control of the

probe to achieve improved accuracy. The Examiner conceded that that Sarkar did not teach or suggest using a sine waveform generator for actuating at least one actuator element. However, the Examiner asserted that it would have been obvious to use a "sine waveform generator" as taught by Flecha "to drive the stage in order to more accurately detect the sample on the stage by varying the height with respect to the probe."

Applicants submit that the Examiner has failed to establish a prima facie case of obviousness. Sarkar has the same deficiencies as discussed in detail above with respect to the construction of its fully released flexure stage. Claims 2-3 depend from claim 1, which recites a structural relationship not taught or suggested by Sarkar. Independent claim 4, and claims 5-6 which depend therefrom, also recite structure which is not taught or suggested by Sarkar. The Examiner has made no allegations that Flecha et al would correct these significant structural and operational deficiencies in the teachings of Sarkar.

In order to carry his burden to combine reference teachings, the Examiner must demonstrate by evidence that there is some suggestion or motivation *in the prior art* to make the proposed modifications. Here, Sarkar shows a specific arrangement of actuators, flexure elements, and a microstage such that the stage is "fully released" and can be driven simultaneously in the X and Y directions. Flecha describes a scanning probe microscope that includes a fast actuator 22 and a slow actuator 26 for Z-axis movement, and a lateral motion actuator 16 for X-Y axis movement. As described by Flecha, the lateral motion actuator generates relative movement between a sample and a scanning probe *only* when the first drive mechanism (the fast actuator) is within a second predetermined range of movement. See, col. 4, lines 47-52.

Thus, the lateral movement actuator of Flecha is designed to be operated only under certain circumstances in conjunction with the specific fast and slow actuator mechanisms. It is apparent that Flecha's operation is very specifically tied to the combination of fast, slow, and lateral actuator mechanisms. There is nothing in Flecha or Sarkar that would motivate or suggest to one skilled in the art that Flecha's lateral motion actuator could or should be substituted into the very different structure of the fully-released microstage of Sarkar. The Examiner has provided no explanation or reasoning as to how or why such substitution should be accomplished other that making the conclusory statement that the use of such would improve accuracy. The Examiner has made no evidentiary showing that the use of Flecha's lateral motion actuator in Sarkar would have any expectation of improving accuracy in the operation of Sarkar's microstage.

Further, contrary to the Examiner's assertion, Flecha does not teach driving a sample with respect to a scanning probe using a sine waveform generator. What Flecha states is that lateral motion actuator 16 "may drive the sample 12 in x- and y-directions, which are perpendicular to one another, producing a sinusoidal or sawtooth pattern of motion." See, col. 5, lines 32-34. Thus, Flecha teaches the production of side-to-side (i.e., lateral) movement which may result in a sinusoidal or sawtooth scan. Nothing in Flecha teaches or suggests the use of or operation of a sine waveform generator in conjunction with an actuator element to produce such lateral movement.

Finally, with respect to claims 4 (along with dependent claims 5-6) and 13, nothing in either Sarkar or Flecha teaches or suggests operation of an actuator element "driven at the frequency of resonant vibration" of the sample stage as recited in claim 4 or "actuating at least one actuator element to drive said stage at its resonant frequency" as recited in claim 13. The Examiner has not even alleged that such a teaching is found in either of the applied references (and explicitly admits that the references do not so teach later in the Action). For all of the above reasons, applicants submit that claims 2-6 and 13 are patentable.

Also in the Office Action, the Examiner rejected claims 4 and 13 under 35 USC §103 as unpatentable over Sarkar in view of Flecha and Okiguchi (JP 09054097). Claim 4, like claim 1, recites that that the sample stage is "affixed to said at least one fixed support." As discussed in detail above, Sarkar does not teach or suggest such a construction. The rejection is deficient for that reason and should be withdrawn. Additionally, applicants hereby repeat and incorporate by reference their arguments above with respect to the rejection of claims 4 and 13 based on Sarkar in view of Flecha. The rejection is deficient for these additional reasons and should be withdrawn.

Further, the Examiner has now cited Okiguchi in a vain attempt to meet the recitations of claims 4 and 13. Okiguchi relates to the use of a quartz oscillator circuit coupled to a sample stage to permit rapid movement of a probe in the Z-direction toward the surface of a sample without colliding with the sample. Okiguchi teaches nothing with respect to control of an X- or Y-axis actuator. The Examiner has provided no reasoning as to why one skilled in the art would modify Sarkar/Flecha to control Z-axis probe movement, or even if one were to do so, how such a modified device would meet the claims. As Okiguchi relates to Z-axis movement, Okiguchi fails to correct the many

deficiencies of Sarkar and Flecha with respect to the claims. The rejection is not well taken for these additional reasons and should be withdrawn.

Also in the Office Action, the Examiner rejected claim 7 under 35 USC §103 as unpatentable over Sarkar in view of Flecha and Pai (US 6338249), rejected claim 8 under 35 USC §103 as unpatentable over Sarkar in view of Flecha and Elings (US RE 37560), rejected claims 9 and 10 under 35 USC §103 as unpatentable over Sarkar in view of Flecha and Zdeblick (US 4906840), rejected claim 11 under 35 USC §103 as unpatentable over Sarkar in view of Marchman (US 5811796), and rejected claim 15 under 35 USC §103 as unpatentable over Sarkar in view of Flecha, Okiguchi, and Ando et al. Solely for purposes of simplifying an already lengthy response, applicants will not separately argue the patentability of these dependent claims at this time. Rather, applicants will rely on their arguments for patentability, set forth in detail above, with respect to those claims from which claims 7-11 and 15 directly or indirectly depend.

For all of the above reasons, applicants submit that claims 1-13 and 15 are patentable over the cited prior art of record. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
DINSMORE & SHOHL LLP

By Timothy W. Hagan
Timothy W. Hagan
Registration No. 29,001

One Dayton Centre
One South Main Street, Suite 1300
Dayton, Ohio 45402-2023
(937) 449-6400
Facsimile: (937) 449-6405
E-mail: tim.hagan@dinslaw.com